Biomarkers evolution in the non-resolved visible spectrum of the Earth

Marie-Eve Naud,

Robert Lamontagne and François Wesemael

Université de Montréal, Canada

Motivation

- Before the arrival of instruments that will secure the first spectra of terrestrial exoplanets, it is crucial to get a good understanding of what can be learned from those spectra.
- A good starting point is to study the spectrum of the only inhabited planet we know, the Earth.

The research project

- We obtain spectra of the Earth by observing the Earthshine with the 1.6 m telescope at the Observatoire du mont Mégantic (Québec, Canada).
- Our goal is to follow over a year the spectral evolution of the signature of various molecules (water, oxygen, ozone) that, taken together, could be indicators of habitability and/or biological activity. Of great interest also is the Vegetation Red Edge, a spectral signature of vegetation that might provide a direct evidence of life.

OBSERVATOIRE DU MONT MÉGANTIC

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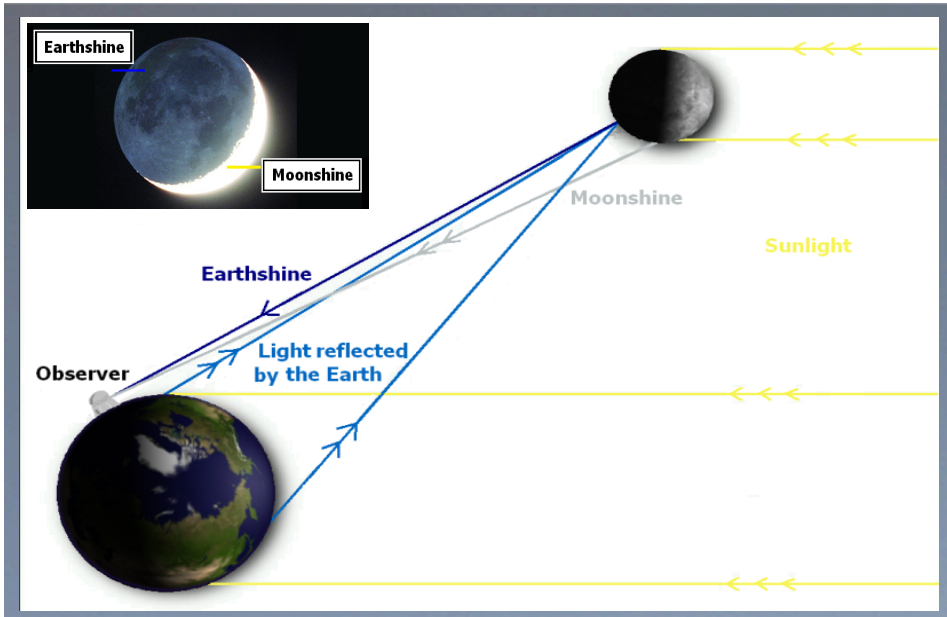
CRSNG NSERC

CRAQ



Earthshine: Weak glow of the portion of the Moon's disk that is lit by sunlight reflected from the Earth.

Earthshine spectrum

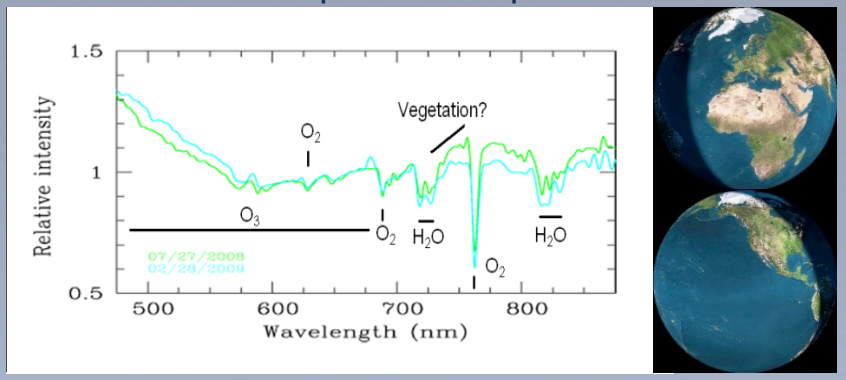
- Provides unresolved information on the Earth.
- Varies according to the portion of the Earth that reflects the light toward the Moon (depends on the lunar phase and the longitude of the observer).

Observatoire du mont Mégantic

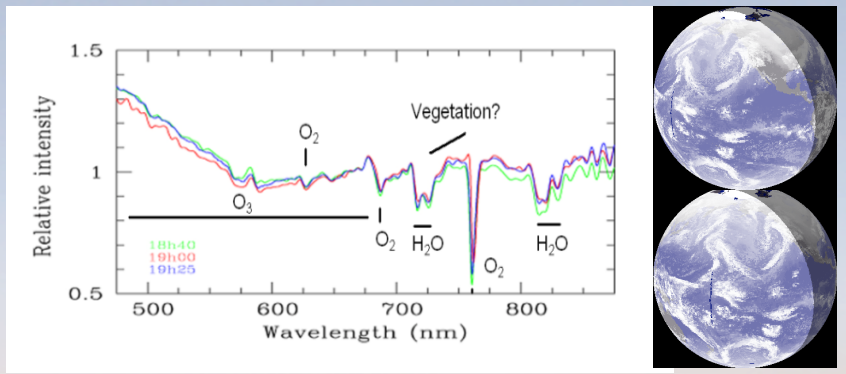
- Located in Quebec (45°3N, 71°9W), it provides a unique longitude location for observations.
- A lot of telescope time available: the evolution of the spectrum is followed over different timescales (hour, month, year).
- Large spectral coverage: from 400 nm to 2.5 µm.

Results

Here are some sample visible spectra obtained:



Left: Earth's spectrum on July 28th, 2008, around 3:50AM, and on Feb. 28th, 2009, around 7:00PM.
Upper Right: The portion of the Earth contributing to the spectrum taken in July, after New Moon. Africa and part of the Atlantic ocean are in sight.
Bottom right: Portion contributing to the February 28th spectrum, before New Moon. the portion contributing is America and part of the Pacific ocean.



Left: Earth's spectrum on February 28th, 2009 at 6:40PM (local time), 7:00PM and 7:25PM.
Upper Right: The global cloud cover around 6:30PM.
Bottom Right: The global cloud cover around 8:30PM.

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